

REMARKS

Entry of the foregoing amendments, and reconsideration of the subject application, in light of the following remarks, are respectfully requested.

No new issues have been raised by this amendment.

Claim 10 has been amended; Claims 1-4, 6, and 20 have been cancelled; Claim 38 has been added; and consequently, Claims 5, 7-19, and 21-38 are now present in this application.

Applicant acknowledges and sincerely appreciates the interview granted by Examiner Luu as a means for expediting the prosecution of this patent application toward allowance.

Rejections under 35 U.S.C. 112, Second Paragraph:

Claim 10 stands rejected under 35 U.S.C. §112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter of the invention, which rejection is respectfully traversed. Claim 10 has been amended to more simply and clearly claim the invention and thereby obviate the rejection.

Should the rejection be maintained, it is requested that the rejection specify why the language used in the claim, as now amended, is not conventional and would not be understood by one of ordinary skill in this art. *In re Kamal*, 158 U.S.P.Q. 320 (C.C.P.A. 1968); *In re Borkowski*, 164 U.S.P.Q. 642 (C.C.P.A. 1970); *Orthokinetics Inc. v. Safty Travel Chairs, Inc.*, 1 U.S.P.Q.2d 1081 (Fed. Cir. 1986).

Rejections under 35 U.S.C. 103

Claims 5, 7-19, and 21-37 stand rejected hereunder as obvious over the combination of Brandon and Hemsley, and optionally further in combination with Veau, Bagepalli, Dalton, and/or Sanders. These rejections are respectfully traversed.

The thrust of the rejection is that the combination of Brandon and Hemsley renders obvious a retractable packing having a brush seal. It is suggested, however, that there is no motivation other than hindsight to combine these two references. Brandon discloses a retractable segmented packing ring, wherein ring segments are biased outwardly so as to avoid damage that would otherwise result from the transient deviations of the shaft during low pressure stages of operation. Hemsley has been added to the rejection for its disclosure of a brush seal in a packing ring. The main purpose of the Hemsley brush seal is to absorb, by bending of the bristles, transient deviations of the shaft from its normal

running position, thereby nullifying any effects of wear on the shaft and prevent local heating leading to axial stresses which could bend the shaft (Page 5, 1st paragraph); hence, Hemsley's ring is biased inwardly. These references thus teach away from each other. Hemsley's choice is to sacrifice the brush to protect the shaft from the effects of wear and to prevent local heating that leads to axial stresses which could bend the shaft. Brandon, on the other hand, uses retractable ring segments, thereby avoiding damage to the segments at the expense of compromising the seal. Thus, Brandon has already compensated for these transient deviations by providing that the packing ring comprise segments that are retracted during start-up where these transients occur. Furthermore, Brandon fails to disclose a brush seal. While applicants understand that the rejection is based on a combination of the two references, it is applicants' contention that the combination of these two references is not obvious, and since these references teach away from each other, their combination is improper.

In order to shed more light upon Applicant's contention, enclosed is an article by R.F. Beatty, entitled "Differentiating Rotor Response Due to Radial Rubbing" published in the April 1985 edition of the Journal of Vibration, Acoustics, Stress, and Reliability in Design. According to the Beatty article, radial rubbing has been a problem for quite some time. Specifically, on the 6th page (1st col., bottom, and Fig. 21) the article

explains that seal rubbing above the first critical speed is benign as compared to seal rubbing below the first critical speed, wherein "rubbing occurring below the critical speed would set up a detrimental cycle of local heating on the heavy side of the rotor" which is "followed by shaft distortion". Thus, the normal brush seal design as in Hemsley will rub below the first critical speed and is likely to cause detrimental rotor vibration and machine reliability problems. This vibration is especially detrimental in huge turbines that often span as much as a city block. Brandon's retractable ring design is a clear attempt to avoid this problem. Nevertheless, Brandon did not incorporate a brush seal, which may not be proof positive of the non-obviousness of the above combination, it does raise some questions. Taken together with the fact that brush seals have been around for quite some time, and that participants in this field are very few and very aware of the latest advancements and innovations, the non-obviousness of the claimed combination becomes evident.

Finally, in traversal of this rejection, Applicants again refer to the Declaration of Richard Shifler under 37 C.F.R. § 1.132. In substantive part, Mr. Shifler asserts in his declaration that in his experience of almost 50 years in the steam turbine industry (§ 3), he was not aware of any prior art device or publication that disclosed or incorporated a brush seal element as a part of the seal member of a retractable seal (§ 16). The cited Hemsley patent, which is a non-retractable seal (§ 17), includes a

spring that biases the seal *towards* the shaft, which is directly contrary to the bias direction taught in the Brandon patent (§ 18). Again, the references teach away from each other.

As Mr. Shifler explains, the Hemsley arrangement keeps the seal against the shaft, and while the seal may have some give away from the shaft during a transient, the disclosed arrangement whereby the seal is always at a small clearance position will not prevent damage to the seal (§§ 19-21). In fact, the Hemsley arrangement requires the brush to be constantly rubbing against the shaft, thereby causing excessive wear and likely differential heating of the shaft, which causes that portion to bow outwardly, exacerbating the likelihood of damage to the seal from the shaft (§22), and result in the problems discussed in the Beatty article.

The combination of a brush seal with a retractable packing is not as straightforward as assumed in the rejection. Mr. Shifler explained that there is a complex interaction of forces necessary to both open and close a conventional retractable packing, and adding a brush seal further complicates the matter (§§ 24-28). For example, not all steam pressure forces act to close the seal: while the pressure drop over the high pressure end does tend to close the seal, the pressure drops at the low pressure end actually tend to open the seal (§§ 29-30). Further, if the brush is in contact with the shaft, it will wear over time, changing the force

distribution, thereby complicating the design in ways not appreciated by either Brandon or Hemsley.

Thus, one can readily add a brush to the stationary packing described in the Hemsley patent and expect it to work, but such is not so readily apparent when a brush is added to the retractable seal described by Brandon (§ 32).

Accordingly, the allegation that it would have been obvious to combine "the brushes as taught by Hemsley with the invention of Brandon so that bending of the bristles absorb transient deviation of the shaft from its normal running position to nullify any effects of wear on the shaft and prevent local heating leading to axial stresses which could bend the shaft" is not well taken in light of Mr. Shifler's declaration. In the present invention "the bending of the bristles" do not absorb the transients, but rather the seal is at a larger clearance that prevents both the bristles and the other elements of the seal (such as the teeth) from damage due to the transients. Further, the bending of the bristles still does not alleviate the problem of localized heating presumed in the rejection because Hemsley specifically teaches that the bristles are always in contact with the shaft, and so there is always localized heating.

The addition of Veau or Bagepalli does not add anything to the rejection. As Mr. Shifler notes, Veau is directed to a conventional brush seal (§ 33). The alleged obviousness of the construction of a portion of

the claimed invention, namely the brush portion, does not render obvious the whole of the claimed invention, namely a retractable seal having a brush portion.

The addition of Dalton is not believed to be warranted if the issue is the conventional structure of the turbine, because Applicant is not claiming changes to that structure, but rather an improvement on a seal that can be used in a conventional turbine.

New claim 38 has been added, which focuses on the combination of the components of the packing ring that make the present application patentable, without the additional functional language recited in the previous claims.

Attached hereto is a marked version of claim 10 to show changes made by the current amendment. The attached page is captioned **"VERSION WITH MARKINGS TO SHOW CHANGES"**

Conclusion

In accordance with the above discussions, it should be clear that neither Brandon, Hemsley, Veau, Bagepalli, Dalton nor the rest of the prior art of record, which were not specifically cited in formulating the

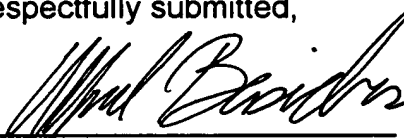
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rejection, taken alone or in combination, disclose or suggest the claimed invention.

In light of the foregoing, the application is now believed to be in proper form for allowance of all claims and notice to that effect is earnestly solicited.

Reconsideration and allowance of the claims is respectfully solicited.

Respectfully submitted,


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APPENDIX

10. (Fourth amendment) A packing ring for use in forming a seal with a turbine shaft rotatably mounted within the casing of an axial flow elastic fluid turbine, wherein said axial flow elastic fluid turbine includes at least one stage having (i) at least one diaphragm stationarily mounted in said casting and having a plurality of steam directing nozzles, and (ii) a rotor fixedly attached to said turbine shaft and having a plurality of blades bounded by a shroud and disposed adjacent said plurality of steam directing nozzles, said packing ring ~~comprising~~ having a plurality of packing ring segments, ~~each said packing ring segment being adapted to be~~ mounted in a groove circumferentially in said diaphragm for forming a seal with said turbine shaft;

~~said packing ring comprising a plurality of packing ring segments,~~
each said packing ring segment comprising:

an inner ring portion having a plurality of brush segments mounted within a brush mounting groove formed in said inner ring, each said brush segment having a packet of bristles with said bristles having tip portions trimmed to terminate along a radius of curvature adapted to form a steam seal with said turbine shaft, each said bristle being adapted to be disposed in a plane substantially parallel to the principal plane of said rotor and extending in the direction of rotation of said turbine shaft;



an outer ring portion adapted to be disposed within said circumferential groove for both axial and radial movement of said segment therein and having a pair of shoulders extending axially in opposite directions adapted for making radial contact respectively with a pair of spaced apart shoulders on said casing and thereby adapted for limiting movement of said segment radially with respect to said shaft;

a neck portion connected between said inner arcuate portion and said outer ring portion and adapted for extending between said casing shoulders, said neck portion having an axial thickness which is adapted to be less than the distance between said opposing casing shoulders to thereby be adapted to axially locate said seal ring segment against one of said casing shoulders and provide a contact pressure seal at the ~~said~~ side of said neck portion which is subject to lower turbine fluid pressure; and

a radial positioning means comprising a spring against said ring segments adapted to forcibly cause said segments to move radially outward away from said shaft, whereas working fluid flowing into to the annular space between said casing and said ring segments will urge said segments radially inward towards said shaft, whereby at low speed and small turbine loads the spring forces will predominate, while at high flows and high working fluid pressure the pressure forces will predominate.

